

Remarks

This Preliminary Amendment cancels, without prejudice, claims 1-4 in the underlying PCT Application No. PCT/DE2004/001605 and adds new claims 5-8. The new claims, inter alia, conform the claims to United States Patent and Trademark Office rules and do not add any new matter to the application.

In accordance with 37 C.F.R. § 1.125(b), the Substitute Specification (including Abstract) contains no new matter. The amendments reflected in the Substitute Specification (including Abstract) are to conform the Specification and Abstract to United States Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. §§ 1.121(b)(3)(ii) and 1.125(c), a Marked-Up Version of the Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. Approval and entry of the Substitute Specification (including Abstract) are respectfully requested.


The underlying PCT Application No. PCT/DE2004/001605 includes an International Search Report, dated May 4, 2005, a copy of which is included. The Search Report includes a list of documents that were considered by the Examiner in the underlying PCT application.

Applicants assert that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

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Dated: 3/13/06

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SENSOR

Background Information

~~The present invention is directed to a sensor according to the definition of the species in the main claim.~~

A method for transferring data from at least one sensor to a control unit is known

- 5 from described in German Patent Application No. DE 101 14 504 A1, where it is described that in which the sensor is connected to the control unit via a two-wire line and receives power for its operation via this two-wire line. The sensor then permanently transfers its measured data via the two-wire line using current modulation. After the power is received, the sensor transmits immediately, first
- 10 transferring a sensor identification, a status identification and sensor values to the control unit as data.

Advantages of the Summary Of The Invention

- 15 In contrast, ~~the~~ The sensor according to the present invention ~~having the features of the independent claim~~ has the advantage that it is now possible to connect a plurality of sensors in parallel to one line. In order to provide each sensor with a possibility of transmitting its data, this data is sent in successive time slots. The triggering event for transmitting is an increase of the power on the line to a first higher level by the control unit. The sensors detect this increase in power so that this point in time
- 20 causes the timing sequence control system in the individual sensors to be triggered. Each timing sequence control system in each sensor tells the individual sensor when it may transmit. The timing sequence control systems are coordinated with one another so that it is impossible for the sensor data to overlap during transmission. The procedure ends when the last sensor has transmitted its data. It is possible for
- 25 the first sensor to resend its data so that all sensors can transmit their data cyclically. However, it is also possible that after the data of the last sensor is transmitted, the control unit will return the power level to a zero level in order to increase the power level again and trigger the transmission of the sensors' data.

- 30 Crash sensors, precrash sensors, but also occupant position sensors, such as weight sensors or video sensors, may be considered as sensors. They may be connected to a common line but also to various lines so that one type of sensor is

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MARKED-UP VERSION OF SUBSTITUTE SPECIFICATION

constantly connected to one line. The sensor of the present invention is configured very simply in order to make unidirectional data transfer from the sensor to a control unit possible without having to use bus technology. The transmission is entirely event-controlled and proceeds without elaborate bus protocol communications. This results in high reliability and a cost-effective and simple product. In particular, the sensors may be designed to be very simple with respect to their electronics. In particular, the present invention makes it possible for the sensors to be connected to the line in parallel.

All sensors are thus connected in parallel to an interface circuit. A specific time interval is assigned to each sensor, for example, by programming a parameter in the sensor. The line is normally configured as a two-wire line. However, it is also possible to configure it as a single-wire circuit. The feed of the first power level, i.e., connecting the voltage or changing a voltage level, provides the start signal for the transfer of data from the sensors to the control unit. The timing sequence control system in the sensors ensures that each sensor transmits its data only in the time interval assigned to it. The time intervals and the times of data transfer are designed to avoid overlapping.

~~The measures and enhancements recited in the subclaims permit advantageous refinements of the sensor defined in the independent claim.~~

It is advantageous in particular that a second power level is constantly supplied to the sensor, the second one being lower than the first power level, i.e., it does not give the signal to transmit. This second power level that is characterized by a second voltage ensures that the sensor is constantly in operation, i.e., the sensor is not reset when the first power level is switched on.

It is a further advantage that the sensors have means for detecting the voltage or the voltage change in order to detect the first or second power level.

Drawing

~~Exemplary embodiments of the present invention are depicted in the drawing and explained in greater detail in the following description in which:~~

Brief Description Of The Drawings

Figure 1 shows a block diagram of the present invention and

Figure 2 shows a flow chart.

5 Detailed Description

In automotive engineering, crash sensors and sensors for detecting the position of occupants are connected by lines to a control unit which activates restraining means. It has become generally accepted that this communication is frequently
 10 unidirectional, i.e., from the sensors to the control unit but not vice versa. However, one sensor has a single line to the control unit and a second sensor has another line. This limits the number of sensors connectable to a control unit. The term line in this case describes a line having two wires; however, a single-wire line is also possible.

According to the present invention, a type of quasi-bus is implemented, the
 15 transmission of the sensors being time-controlled. The triggering event for the timing sequence control system is an increase of the power on the line, to which the sensors are connected in parallel. The first sensor then detects, as do all the other sensors, the increase to a first power level and thus the point in time is given which is critical for the timing sequence control system. Each sensor is then given a time
 20 slot assigned by its timing sequence control system for sending its data to the control unit. These time slots have already been programmed by the manufacturer in such a way that they do not overlap. The manufacturer thus provides coordination of the transmission slots.

Figure 1 illustrates the present invention in a block diagram. Sensors S1, S2 to Sn are connected to a control unit SG in parallel to one another via a line L, which is designed as a two-wire line. Voltage level US is applied to line L. This voltage level US is impressed on line L by control unit SG. Control unit SG is thus used as a
 25 power source for sensors S1, S2 to Sn connected to line L. The control unit uses the power consumption to verify the number of sensors connected to line L. No power supply lines are provided for sensors S1, S2 to Sn nor is energy storage provided in
 30 sensors S1, S2 to Sn. The sole supply of power for sensors S1, S2 to SN is via line L. Sensors S1, S2 to Sn transfer data unidirectionally to control unit SG which has a receiver module for receiving these data. As a function of these data, control unit SG

activates, for example, restraining means such as airbags or belt tensioners. To prevent collisions between the data of individual sensors S1, S2 to Sn on line L, a mechanism is provided which controls the transmission of individual sensors S1, S2 to Sn. According to the present invention, the variation of voltage US on line L

5 initiates the transmission process while each of individual sensors S1, S2 to Sn has a timing sequence control system which is designed in such a way that it assigns a time slot for transmission to each of sensors S1, S2 to Sn, i.e., overlaps of these time slots are avoided. For that reason, timing sequence control system in individual sensors S1, S2 to Sn must already be set by the manufacturer in order to coordinate
10 these time slots with one another. In this case, this means that sensor S1 first transmits its data in one time interval and sensor 2 then sends its data in a subsequent time interval. This is carried out until last sensor Sn has sent its data.

It is then possible for Sensor S1 to transmit its data in a predetermined time interval
15 so that a cyclical loop is present for transmitting the sensor data.

However, it is also possible that after sensor Sn has transmitted its data, control unit SG reduces the voltage on line L to terminate the transmission. The event that triggers the transmission is the increase of voltage US. Voltage US may be
20 increased abruptly or gradually. If voltage US exceeds a threshold value which is tested by individual sensors S1, S2 to Sn, the point in time is then set at which timing sequence control system starts. Voltage US represents a power level that is assigned to sensors S1, S2 to Sn. In the phase in which the voltage level that prompts the transmission of data is not maintained on line 1, a rest phase voltage U1
25 is present which makes operation of the sensors possible without it being necessary for them to perform a reset when they are supposed to transmit again. As an alternative, it is also possible for voltage US to be raised above the threshold only briefly in order to trigger the event and then return to a lower voltage level because it is then no longer necessary to trigger the event. However, it may, as stated, be
30 maintained at the increased voltage level for the entire transmission phase.

A timing diagram is also shown under the block diagram in Figure 1. It is a voltage-time diagram that shows both voltage US and the transmission phase of the individual sensors. Initially, voltage level US is at voltage Uoff.

The voltage may be switched on and off by the control unit. As a result, it may be possible, for example, for the sensor to be reset. Normally, the sensor is switched on once by the control unit after the motor vehicle is started (voltage on US) and then stays on until the ignition is switched off again.

The voltage is then increased to value U1 which does not yet trigger the transmission of sensors S1, S2 to Sn but it supplies them with enough power without which they would have to perform a reset when they were supposed to transmit.

Finally, voltage US is increased to value U2 for a predetermined time segment. In this time segment, individual sensors S1 to Sn transmit their data S1, S2 to Sn in time segments Ts1, Ts2 to Tsn. After this time segment, control unit SG again reduces voltage US to the value U1 and then increases it again to the value U2 so that the transmission cycle may then be restarted. As stated, alternatives are possible; specifically, it is possible to increase voltage US only briefly to voltage U2 in order to trigger the event, or voltage US may persist at voltage U2 and the sensors will send their data cyclically.

Figure 2 elucidates the present invention in a flow chart. In step 200, voltage US is increased from the value U1 to the value U2 in order to trigger transmission by sensors S1, S2 to Sn. In step 201, sensors S1, S2 to Sn detect that the voltage has been increased. For this purpose, an absolute value detection or a voltage change (detection) may be considered. This increase triggers the start of the timing sequence control system in step 202. In step 203, individual sensors S1, S2 to Sn transmit the data in their assigned time slots. In step 204, control unit SG reduces the voltage of U2 to U1 after the last sensor has transmitted its data. The process ends in step 205. As shown above, there are several possibilities for carrying out this process cyclically or in a controlled manner by increasing and reducing voltage US on line L.

Abstract Of The Disclosure

A sensor has a transmitter module for transferring data via a line, the sensor receiving power via the line. At a point in time in which the sensor receives a first power level, it transmits the data for a first time interval. A second sensor which is connected to the line in parallel to the first sensor then transmits its data for a second time interval after the first time interval. A timing sequence control system in the two sensors which is triggered by the point in time of reception of the power ensures the subsequent transmission by the first and second sensor.

10 ~~(Figure 1)~~